

What is claimed is:

1. A piezoelectric/electrostrictive device comprising a driving portion to be driven by a displacement of a piezoelectric/electrostrictive element, a movable portion to be operated based on a drive of the driving portion, and a fixing portion for holding said driving portion and movable portion, said fixing portion and said movable portion being coupled via the movable portion, and a hole is formed by inner walls of the driving portion, an inner wall of the movable portion, and an inner wall of the fixing portion, in which the driving portion is composed of a mutually opposed pair of thin plate portions and at least two piezoelectric/electrostrictive elements provided on the thin plate portions; each of said piezoelectric/electrostrictive elements being comprised of one or more pairs of electrodes and a piezoelectric/electrostrictive film; and at least one of ends of said piezoelectric/electrostrictive element and a piezoelectric/electrostrictive operating portion on said at least one of ends are positioned on the fixing portion, and formed as being extended to a least a part of either one of the thin plate portions out of said pair of the thin plate portions, and an end of said piezoelectric/electrostrictive operating portion on another side of said piezoelectric element is positioned on said either one of the thin plate
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portions, in a direction of said one of the thin plate portions from the fixing portion toward the movable portion, in one out of at least two piezoelectric/electrostrictive elements comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive film, and that at least one of the ends of said piezoelectric/electrostrictive element and a piezoelectric/electrostrictive operating portion on said at least one of the ends are positioned on the movable portion, and formed being extended to at least a part of another thin plate portion out of said pair of the thin plate portions, and an end of said piezoelectric/electrostrictive operating portion on another side of said piezoelectric/electrostrictive element is positioned on said another thin plate portion, in a direction of said another thin plate portion from the fixing portion toward the movable portion, in one of remaining piezoelectric/electrostrictive elements among said piezoelectric/electrostrictive elements comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive film.

2. A piezoelectric/electrostrictive device according to claim 1, in which, on an outer surface of at least either one thin plate portion of a pair of mutually opposing thin plate portions, a piezoelectric/electrostrictive element comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive film further having, in a

- direction of the thin plate portions from the fixing portion toward the movable portion, at least one end of the piezoelectric/electrostrictive element and a piezoelectric/electrostrictive operating portion of the same end side
- 5 thereof arranged on the fixing portion or the movable portion, and formed being extended to at least a part of the thin plate portion, and an end of a piezoelectric/electrostrictive operating portion of the other end side of said piezoelectric/electrostrictive element being arranged
- 10 on the thin plate portion, a piezoelectric/electrostrictive element thereof being arranged on the same thin plate portions mutually opposed to one out of the at least two piezoelectric/electrostrictive elements arranged so as to be in the diagonal directions across the hole.
- 15 3. A piezoelectric/electrostrictive device according to claim 1, in which, on respective outer surfaces of the pair of mutually opposing thin plate portions, in a direction of the thin plate portion from the fixing portion toward the movable portion, a piezoelectric/electrostrictive element comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive film, one end thereof being arranged on the fixing portion, and a piezoelectric/electrostrictive element comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive film, one end thereof being arranged on the movable portion, being
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respectively arranged mutually opposed on the same thin plate portion, the respective piezoelectric/electrostrictive elements having one end thereof and a piezoelectric/electrostrictive operating portion of the same end side thereof
5 arranged on the fixing portion or the movable portion, and formed being extended to at least a part of the thin plate portion, and an end of a piezoelectric/electrostrictive operating portion of the other end side of said piezoelectric/electrostrictive element being arranged on the
10 thin plate portion.

4. A piezoelectric/electrostrictive device according to claim 2, in which ends of piezoelectric/electrostrictive operating portions on the thin plate portions of respective piezoelectric/electrostrictive elements provided mutually
15 opposed on the outer surface of the same thin plate portion are arranged at positions not to exceed one half of the length of respective thin plate portions.

5. A piezoelectric/electrostrictive device according to claim 3, in which ends of piezoelectric/electrostrictive operating portions on the thin plate portions of respective piezoelectric/electrostrictive elements provided mutually
20 opposed on the outer surface of the same thin plate portion are arranged at positions not to exceed one half of the length of respective thin plate portions.
25 6. A piezoelectric/electrostrictive device according to

claim 2, in which two piezoelectric/electrostrictive elements provided mutually opposed on the outer surface of the same thin plate portion share a piezoelectric/electrostrictive film.

- 5 7. A piezoelectric/electrostrictive device according to claim 3, in which two piezoelectric/electrostrictive elements provided mutually opposed on the outer surface of the same thin plate portion share a piezoelectric/electrostrictive film.
- 10 8. A piezoelectric/electrostrictive device according to claim 2, in which two piezoelectric/electrostrictive elements provided mutually opposed on the outer surface of the same thin plate portion out of a pair of mutually opposing thin plate portions are elements respectively having the same or different functions.
- 15 9. A piezoelectric/electrostrictive device according to claim 3, in which two piezoelectric/electrostrictive elements provided mutually opposed on the outer surface of the same thin plate portion out of a pair of mutually opposing thin plate portions are elements respectively having the same or different functions.
- 20 10. A piezoelectric/electrostrictive device according to claim 9, in which two piezoelectric/electrostrictive elements provided mutually opposed on the outer surface of the same thin plate portion out of a pair of mutually

opposing thin plate portions are elements having respectively different functions.

11. A piezoelectric/electrostrictive device according to claim 1, in which piezoelectric/electrostrictive elements existing mutually in diagonal directions across the hole out of at least two piezoelectric/electrostrictive elements provided on the outer surfaces of a pair of mutually opposing thin plate portions are elements having the same function.
- 10 12. A piezoelectric/electrostrictive device according to claim 2, in which piezoelectric/electrostrictive elements existing in mutually diagonal directions across the hole out of at least two piezoelectric/electrostrictive elements provided on the outer surfaces of a pair of mutually opposing thin plate portions are elements having the same function.
- 15 13. A piezoelectric/electrostrictive device according to claim 3, in which piezoelectric/electrostrictive elements existing mutually in diagonal directions across the hole out of at least two piezoelectric/electrostrictive elements provided on the outer surfaces of a pair of mutually opposing thin plate portions are elements having the same function.
- 20 14. A piezoelectric/electrostrictive device according to claim 1, in which piezoelectric/electrostrictive elements
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existing in mutually diagonal directions across the hole out
of at least two piezoelectric/electrostrictive elements
provided on the outer surfaces of a pair of mutually
opposing thin plate portions are elements having mutually
5 different functions.

15. A piezoelectric/electrostrictive device according to
claim 2, in which piezoelectric/electrostrictive elements
existing in mutually diagonal directions across the hole out
of at least two piezoelectric/electrostrictive elements
10 provided on the outer surfaces of a pair of mutually
opposing thin plate portions are elements having mutually
different functions.

16. A piezoelectric/electrostrictive device according to
claim 3, in which piezoelectric/electrostrictive elements
15 existing in mutually diagonal directions across the hole out
of at least two piezoelectric/electrostrictive elements
provided on the outer surfaces of a pair mutually opposing
thin plate portions are elements having mutually different
functions.

20 17. A piezoelectric/electrostrictive device according to
claim 1, in which at least one
piezoelectric/electrostrictive element out of at least two
piezoelectric/electrostrictive elements provided on the
outer surfaces of a pair of mutually opposing thin plate
25 portions has a multi-layered piezoelectric/electrostrictive

operating portion.

18. A piezoelectric/electrostrictive device according to
claim 2, in which at least one

piezoelectric/electrostrictive element out of at least two
5 piezoelectric/electrostrictive elements provided on the
outer surfaces of a pair of mutually opposing thin plate
portions has a multi-layered piezoelectric/electrostrictive
operating portion.

19. A piezoelectric/electrostrictive device according to
10 claim 3, in which at least one piezoelectric/electro-
strictive element out of at least two piezoelectric/electro-
strictive elements provided on the outer surfaces of a pair
of mutually opposing thin plate portions has a multi-layered
piezoelectric/electrostrictive operating portion.

Abstract of the Disclosure

Provided is a piezoelectric/electrostrictive device comprising a driving portion to be driven by a displacement of a piezoelectric/electrostrictive element, a movable portion to be operated based on a drive of the driving portion, and a fixing portion for holding the driving portion and the movable portion, the fixing portion and the movable portions being coupled via the driving portion, and a hole being formed by an inner wall of the driving portion, inner wall of the movable portion, and inner walls of the fixing portion. The driving portion comprises a pair of mutually opposing thin plate portions and at least two piezoelectric/electrostrictive elements each comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive layer provided on the thin plate portions. In case of one out of at least two piezoelectric/electrostrictive elements comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive layer at least one of ends of said piezoelectric/electrostrictive element and a piezoelectric/electrostrictive operating portion on said at least one of ends are positioned on the fixing portion, and formed as being extended to a least a part of either one of the thin plate portions out of said pair of the thin plate portions, and an end of said

piezoelectric/electrostrictive operating portion on another side of said piezoelectric element is positioned on said either one of the thin plate portions, in a direction of said one of the thin plate portions from the fixing portion 5 toward the movable portion. In the case of one of remaining piezoelectric/electrostrictive elements among said piezoelectric/electrostrictive elements comprising at least one or more pairs of electrodes and a piezoelectric/electrostrictive layer, at least one of the ends of said piezo- 10 electric/electrostrictive element and a piezoelectric/electrostrictive operating portion on said at least one of the ends are positioned on the movable portion, and formed being extended to at least a part of another thin plate portion out of said pair of the thin plate portions, and an 15 end of said piezoelectric/electrostrictive operating portion on another side of said piezoelectric/electrostrictive element is positioned on said another thin plate portion, in a direction of said another thin plate portion from the fixing portion toward the movable portion. Said piezo- 20 electric/electrostrictive device is capable of further increasing a displacement quantity of a movable portion while maintaining the mechanical strength at the joined portion of the thin plate portion with the movable portion above the predetermined level, and may be used a 25 displacement element being high in resonant frequency and

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superior in responsibility, and a sensor element capable of detecting vibrations of the movable portion in finer precision.